Melting Temperatures from Rapidly Heated Coated Wires

D. Josell, D. Basak, J.L. McClure, U.R. Kattner, and W.J. Boettinger
Metallurgy Division
National Institute of Standards and Technology
Gaithersburg, MD 20899 U.S.A.

Two new experimental approaches demonstrate expanded capabilities for rapid heating experiments. Both modify the standard wire geometry used in our laboratory by depositing a (< 20 μm thick) coating on the surface of the wire. The first approach uses the coating to permit study of the underlying *wire* properties (e.g., to study high vapor pressure materials). The second approach uses the wire to permit study of the *coating* properties (e.g., for materials that are nonconductive or difficult to fabricate in bulk). In both types of experiment, electrical currents are passed through the specimens to obtain heating rates prior to melting of 5×10^3 to 5×10^4 $K\cdot s^{-1}$. Simultaneous measurement of the radiance temperature (pyrometry) and spectral emissivity (polarimetry) at the surface of the coating permits real time determination of the true temperature and emissivity histories of the specimens through melting. The temperature of the coating surface does not differ significantly from the temperature of the underlying wire for the thicknesses and thermal diffusivities of these coatings and the heating rates used in these studies.

In the first study, the melting point of chromium is obtained from the melting of tungsten-coated chromium wires. The tungsten coatings (approximately 10 microns thick) serve only to suppress evaporation of the high vapor pressure chromium, thus permitting accurate determination of the chromium melting point. A plateau in the true temperature-time data marks the inception of melting of the substrate.

In the second study, the melting point of titanium coatings on molybdenium wires is determined. A sharp decrease in the spectral emissivity marks the inception (true temperature) of melting of the coating. The wire serves merely as a conductive substrate for the material of interest. The results from these experiments demonstrate the importance of the high heating rates on the validity of such measurements.

Changes of the melting behavior observed in both types of experiments at slower heating rates are analyzed in terms of interdiffusion between the coatings and the substrates.